CLAIMS

What is claimed is:

1. A thermoelectric nanogranular material with an enhanced Seebeck coefficient, comprising:

a processed thermoelectric nanogranular material including particles having a grain size d;

wherein d is characterized by the relationship $mfp/2 < d < 5mfp$; and

wherein mfp is the phonon-limited mean free path of an equivalent bulk thermoelectric material prior to processing a bulk thermoelectric material into the processed thermoelectric nanogranular material having a grain size d.

2. The thermoelectric nanogranular material of claim 1, wherein the thermoelectric nanogranular material includes PbTe.

3. The thermoelectric nanogranular material of claim 2, wherein the grain size d of the PbTe thermoelectric nanogranular material is between approximately 10 nm and 100 nm.

4. The thermoelectric nanogranular material of claim 1, wherein the thermoelectric nanogranular material includes one of PbSe, PbS, SnTe, SnSe and their solid solutions.

5. The thermoelectric nanogranular material of claim 1, wherein the thermoelectric nanogranular material includes one of Bi_2Te_3, Bi_2Se_3, Sb_2Te_3, Sb_2Se_3 and their solid solutions.

6. The thermoelectric nanogranular material of claim 1, wherein the thermoelectric nanogranular material includes BiSb.

7. The thermoelectric nanogranular material of claim 1, wherein the grain size d is between approximately 10 nm and 100 nm.

8. A method of making a thermoelectric nanogranular material, comprising the steps of:

preparing a bulk thermoelectric material;

reducing the bulk thermoelectric material into a powder;

processing the powder to retain only those particles having a grain size d, wherein:

d is characterized by the relationship $mfp/2 < d < 5mfp$; and

mfp is the phonon-limited mean free path of the bulk thermoelectric material;

pressing the retained particles at a predetermined pressure; and

sintering the pressed particles at a predetermined temperature for a predetermined period of time in a predetermined atmosphere.

9. The method of claim 8, wherein the step of preparing a bulk thermoelectric material includes preparing a PbTe-based thermoelectric material.

10. The method of claim 9, wherein the processing step includes filtering the powder to retain only those particles having a grain size d between approximately 10 nm and 100 nm.

11. The method of claim 8, wherein the step of preparing a bulk thermoelectric material includes preparing a PbSe, PbS, SnTe or SnSe material.

12. The method of claim 8, wherein the step of preparing a bulk thermoelectric material includes preparing a Bi_2Te_3, Bi_2Se_3, Sb_2Te_3 or Sb_3Se_3 material.

13. The method of claim 8, wherein the step of preparing a bulk thermoelectric material includes preparing a BiSb material.

14. The method of claim 8, wherein the step of preparing a bulk thermoelectric material includes alloying the bulk material to endow the material with the desired electron or hole density.

15. The method of claim 8, wherein the reducing step includes ball-milling the bulk thermoelectric material in n-Heptane.

16. The method of claim 8, wherein the reducing step includes ball-milling the bulk thermoelectric material in an inert atmosphere.

17. The method of claim 8, wherein the reducing step includes alloying the bulk thermoelectric material to influence the thermoelectric properties.

18. The method of claim 8, wherein the pressing step includes isostatically or uniaxially pressing the retained particles.

19. The method of claim 8, wherein the sintering step includes sintering the pressed particles at approximately 350°C to 450°C for between about 15 minutes and 200 hours.

20. The method of claim 19, wherein the sintering step includes sintering the pressed particles at approximately 350°C for between 150 and 200 hours.

21. The method of claim 19, wherein the sintering step includes sintering the pressed particles at approximately 450°C for about 15 minutes.

22. The method of claim 19, wherein the sintering step includes sintering the pressed particles for approximately 160-170 hours.

23. The method of claim 8, wherein the sintering step includes sintering the pressed particles in a reducing atmosphere.

24. The method of claim 8, wherein the sintering step includes sintering the pressed particles in hydrogen gas.

25. The method of claim 8, wherein the step of reducing the bulk thermoelectric material includes adding fullerene (C60) powder to the bulk thermoelectric material.